Sequencing and Navigation in Simulation-based Training

Jacqueline A. Haynes and Preetam Maloor
Intelligent Automation, Inc.

Distributed learning systems are now beginning to explore the edges of their currently constrained world. Recent efforts have begun to investigate how inter-operating distributed e-learning applications can include formats previously excluded by their proprietary development and delivery environments and by the limitations of their architecture. ADL, focused first on an effort to overcome the limitation of proprietary formats, resulting in the introduction of SCORM and (soon) CORDRA. However, SCORM conformance seemed like a stifling limitation to instructional developers accustomed to using more powerful instructional designs than SCORM 1.2 supports. However, given the new structures available within the SCORM 2004 specification as well as new architectures combining SCORM with other platforms, new instructional possibilities are wide open. IAI has been exploring these capabilities, especially with respect to combining instruction conforming to SCORM with simulation conforming to the HLA (High Level Architecture) standard for simulation. Some details of this work can be found in Haynes, Marshall, Manikonda and Maloor (2004).

SCORM 2004 provides huge improvements in the instructional architectures that can be implemented, due to implementation of new sequencing and navigation rules. SCORM sequencing and navigation (SSN) can now be used to individualize the instructional experience, thereby making it more efficient; motivating; and effective. Also, learners can experience greater control over their personal learning experience by selecting options best suited to their preferences for detail, learning modality, or level of interaction with other learners, for example. Other stakeholders (employers, schools, or the military, for example) can also benefit from more complex learning environments that can facilitate better quality training and better assessment information about learners performance.

SITA (Simulation-based Intelligent Training and Assessment) is a prototype system[1] designed to provide a model of combining simulation-based training (conforming to HLA) with instruction conforming to SCORM. SITA includes a variety of sequences of instructional events that can be used to explore the 'edges of the envelope' in terms of SSN in SCORM. SITA includes instruction in declarative knowledge (learning 'what' and 'why'), procedural knowledge (learning 'how,' 'when' and 'where') and applied knowledge (using the prior knowledge to perform one or more tasks). While the specific instantiation of this architecture uses an air traffic control task, of course, any distributed simulation conforming to HLA could be substituted.

---

[1] SITA was sponsored by the Joint ADL Co-lab in Orlando, under BAA _____.

The SITA instructional architecture includes SCO's for pre-assessment, didactic instruction, interactive instruction, individual skill practice, team skill practice, knowledge assessment, individual performance assessment and team performance assessment. A SCO launches the simulation, , which then communicates with the simulation federates and the LMS is achieved via the RTI-SCO Interface, the Simulation launcher/collector applet and the LMS Adapter.. Figure 1 illustrates this technical architecture.

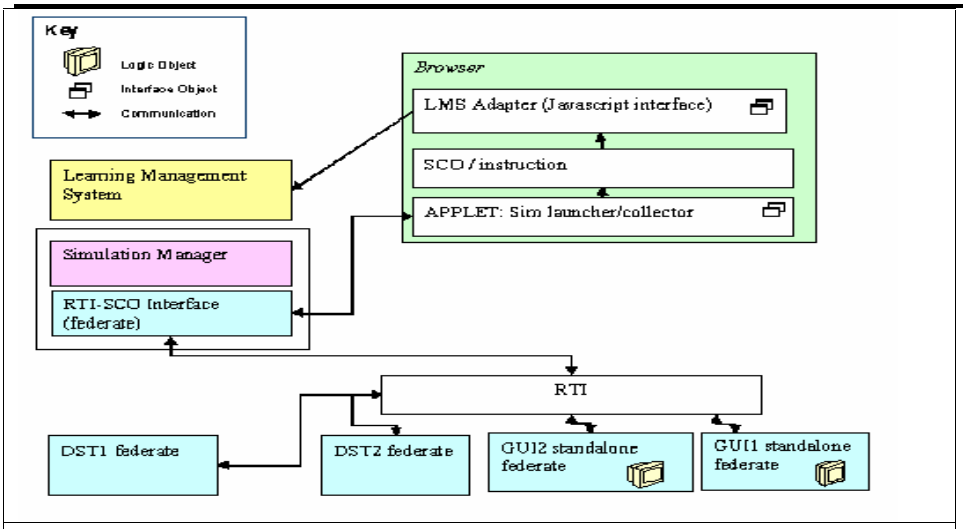

Figure 1: SITA Architecture

While the one-hour course is artificially complex to demonstrate the full scope of possible instructional architectures, it is useful as scenario for considering how and where simulation can be used effectively to achieve various types of outcomes. Currently in SITA, simulation is used for skill practice and performance assessment, both for individuals and teams. Table 1 describes the instructional activities in SITA and the role of SSN in the instructional architecture:

Instructional Activity	**SCORM Sequencing and Navigation**
A *Pre-test SCO* gathers information about he trainee's current state of knowledge and/or performance.	SSN can be used to make the assessment adaptive.
Based on the pre-test, a *Didactic Instruction SCO* introduces the trainee to the new principles of air traffic control called 'collaborative regional flow control, (CRFC)' by description and examples of types of constraints that can be employed to create different effects on airspace efficiency.	SSN is used to direct individual learners to begin their learning experience with different SCOs, depending upon the evidence of their pre-existing knowledge, derived from the pre-test.

With the *Interactive Instruction SCO*, the trainee then learns more specifically about each of the constraints and how they are represented in the CRFC. The SCO uses the simulation's GUI to manipulate each constraint separately, with instruction in what, when, and how to perform the manipulation	SSN is used to direct the trainee's learning experience to include those SCO's dealing with constraints not mastered (as evidenced by the pre-test). Performance on each SCO is evaluated separately (within the SCO), which is only exited upon achieving a level of proficiency.
Following completion of the interactive SCO's AND attainment of threshold scores, The CRFC-DST simulation (see Satapathy, 2002 for detail) is initialized with a scenario selected for the trainee's proficiency level. The trainee practices over a series of until s/he attains a criterion efficiency score. Individual simulation may be followed by team simulation, following the same logic.	SSN is used to permit navigation among different scenarios depending on outcomes in previous simulations. These can be individual simulations, followed by team simulations covering larger regions of airspace.
Assessment SCO's follow instruction and include of two types: performance assessment using simulation, and knowledge assessment using conventional assessment items. Assessment data is reported to the LMS.	SSN is used to make knowledge assessment adaptive, and to identify appropriate scenario(s) for the performance assessment such that what the trainee demonstrates s/he *knows*, is then assessed in simulation to determine whether s/he can *use* that knowledge in task performance. SSN can also provide remediation.

Table 1: SCO's and SSN in SITA

The uses of SSN in SITA are but the beginning of exploration into only one of the many possible instructional architectures that are now supported in SCORM-conforming learning environments. Future R&D efforts will undoubtedly introduce a variety of new instructional architectures into the SCORM distributed learning world/

Satapathy, G., Manikonda, V., Robinson, J. and Farley, T. (2002). En-Route Sector Metering using a Game-Theoretic Approach. AAAI Game Theory and Decision Theory Workshop.

Haynes, J., Marshall, S., Manikonda, V., and Maloor, P. (2004) Enriching ADL: Integrating HLA Simulation and SCORM Instruction using SITA (**S**imulation-based **I**ntelligent **T**raining and **A**ssessment). Interservices/Interindustry Training Education and Simulation Conference. Orlando. December.